# The influence of land use on stream biofilm nutrient limitation across eight North American ecoregions

**Laura T. Johnson, Jennifer L. Tank, and Walter K. Dodds**

**Abstract:** Nutrient diffusing substrata were used to determine the influence of inorganic nitrogen (N) and phosphorus (P) availability on community respiration (CR), gross primary production (GPP), and chlorophyll *a* (chl *a*) on inorganic and organic substrata. We incubated substrata in nine streams each in a total of eight ecoregions ($n$ = 72 streams) located in a range of native vegetation, agriculture, and urban land-use types. On organic substrata, CR was nutrient-limited in 94% of reference streams but showed significant nutrient limitation in only 60% and 65% of agricultural and urban streams, respectively. The relative magnitude of nutrient limitation for CR on organic substrata decreased with increasing percent modified land use in the basin (agriculture + urban). On inorganic and organic substrata, GPP and chl *a* were rarely nutrient-limited across all ecoregions and land-use types, although the magnitude of nutrient limitation increased with increasing light availability. The effect of human land use on nutrient limitation of biofilm CR, GPP, and chl *a* was influenced by ecoregion, yet heterotrophic biofilms were consistently most sensitive to nutrient enrichment across ecoregions. Both heterotrophic and autotrophic biofilm constituents should be considered to fully understand stream ecosystem responses to nutrient enrichment.